SUMMARY

A study on synthesis of Locally Semi-synthetic cutting oils

Our presented includes three main parts, as follows:

A – Introduction

The introduction includes a definition of petroleum industry, types of base oils and its additives since the operations of lubrication consume large amounts of mineral oil in the different processes of metalworking, has evolved the idea of using simple ratios of oil mixed with water these are called cutting oils, so as to allow operational use of the following processes :
(turning, drilling, milling, planing, and grinding, or metal-forming operations, such as rolling, pressing, and deep-drawing) .

The introduction also illustrated the different types of cutting oils including origin, uses, advantages and disadvantages as follows:

1 - Straight oils:

Are non-emulsifiable and are used in machining operations in an undiluted form. They are composed of a base mineral or petroleum oil and often contain polar lubricants such as fats, vegetable oils and esters as well as extreme pressure additives such as Chlorine, Sulphur and Phosphorus. Straight oils provide the best lubrication and the poorest cooling characteristics among cutting fluids.

2 - Soluble Oil:

Fluids form an emulsion when mixed with water (based petroleum oil + emulsifier factors 15 - 25%). The concentrate consists of a base mineral oil and emulsifiers to help produce a stable emulsion. They are used in a diluted form (usual concentration = 3 to 10%) and provide good lubrication and heat transfer performance. They are widely used in industry and are the least expensive among all cutting fluids.

3 - Semi-synthetic fluids:

Their solutions are semi-transparent emulsions with water (based petroleum oil + emulsifier factors 35 - 50%), are essentially combinations of synthetic and soluble oil fluids and have characteristics common to both types. (Safe from bacteria, a relatively non-toxic, good cooling, long period of service, ease of maintenance and storage, can be used more than a day in logging operations).

The disadvantages: (water hardness affect the stability - Easy to pollution by any other liquid into the machine).

4 - Synthetic Fluids:

Contain no petroleum or mineral oil base and instead are formulated from alkaline inorganic and organic compounds along with additives for corrosion inhibition. They are generally used in a diluted form (usual concentration = 3 to 10%). Synthetic fluids often provide the best cooling performance among all cutting fluids.

Objective of the study

This study aims at producing semi-synthetic cutting oils in which the following aspirations are achieved:

1 - To reduce cost and increase the life expectancy.
2 - Raise the efficiency of cutting and grinding abilities.
3 - Fluid's resistance to bacterial attack (more than fifteen days) .
4 - Chemical restrictions and reactivity of fluids towards bearing high Pressure and heat.
5 - Ease of fluid recycling and disposal; without Environmental problems.
6 - The corrosion and rust protection the fluid offers.
7 - Speed, feed and depth of the cutting operation.
8 - Optimal concentration and pH ranges for pH = 9.2.
9 - That is suited to work in the several operation of different metals and alloys.
10 - To be safe; quality control and friendly environmental.

B – EXPERMENTAL

Tow samples of Imported semi-synthetic cutting oils had been analyzed, these oils are shopping in the form of mineral oil containing emulsifier package and added to water to form cutting emulsions which may contain additional additives such as: anti-bacterial growth and also this oils contain additives for extreme-pressure and anti- wear /anti- corrosion additive to enhance cutting properties, as the semi-synthetic cutting oils of the most important problems is the rust formation because to contain a large proportion of the water.

Evaluation tests for semi synthetic cutting oils:

1- Determination of thermal stability of water mix metal working fluids: IP311

This method covers the determination of the thermal stability of water mix metal working fluids over the range of temperatures at which the fluids would normally be stored. Samples of the fluid are stored at 0°C and 50°C and then examined for homogeneity. Doubtful results are checked by determining the dilution stability of the treated fluid, using method IP 263.

2- Emulsion stability: IP263

Water mix metal working fluids used in the form of aqueous dilutions should remain stable in use .This method is accordingly designed to assess the stability of water mix metal working fluids used in the form of aqueous dilutions. A dilution in water of the fluid under test is prepared using a magnetic stirrer. The dilution so prepared is poured into a flask with graduated neck, allowed to stand for a specified time, and any separation measured.

3-Determination of frothing characteristics of water mix metal working fluids: IP312

This method assesses the frothing characteristics of water mix metal working fluids used in the form of aqueous dilutions. An aqueous

dilution of the fluid is shaken in a measuring cylinder and the volume of froth recorded after a specified time.

4 -Anti-corrosion effect: IP125

Was carried out to determine the optimum ratio of synthesized additives as anti-corrosion function for the semi - synthetic cutting fluids on all ratios mentioned above to limit the optimum ratio of blending synthesized additives which gave good results, while in the case of soluble cutting oils the test was carried out at the optimum ratio which already had been given good emulsion stability.

5- Four-ball test: IP 239

The Four Ball Wear Test puts one rotating ball against three fixed balls under specific conditions of pressure, temperature, revolutions per minute and duration. The test may be used to evaluate the friction- and wear-control ability of liquid lubricants or greases in sliding contact. The Four Ball Wear Test is a glaboratory tool for developing oils with good engine wear control.

The welding load should be as high as possible, while the scar diameter should be as low as possible.

6-PH Test:

A mixture of 95 ml distilled water and 5 ml of semi synthetic cutting oil (stirring well) is placed in a beaker ,after that immerse the potentiometric electrode and take the reading (should be between 8 -9) .

Methods for preparation of Locally semi synthetic cutting oil

1 - There were several trials for preparation of locally semi synthetic cutting oils from available raw materials and equal to the imported one, with low cost and more stable .After that the evaluation tests were carried out as previously.

2 - Two additives were synthesized as anti-wear/ anti-corrosion additives, to add it to the successful blends. The additives were synthesized through several trials to obtain the suitable conditions, this additives was Abietic diethanol amide and oleic diethanol amide. The structures of the synthesized additives were illustrated by IR spectroscopic analysis. The

synthesized additives were evaluated as anti-corrosion / anti-wear additives using IP 125 and IP 239 respectively. The results of this evaluation showed that Abeitic diethanol amide &oleic diethanol amide with a dose of 2% & 4% wt. is the best percent.

Two package of semi synthetic cutting oils were prepared, one of theme contain (abeitic diethanol amide) and the other contain (oleic diethanol amide) to make the field test on it in a great industrial company, which is professional in these field.

C - RESULTS & DISCUSSION

Several trials were carried out to prepare completely balance product of emulsifying agents (Ionic compounds and Non ionic compounds), anti rust / antiwear additives and anti-bacteria, which are used as additives in formulating semi synthetic cutting oils with ratio between (30 - 50 %), using the available raw materials.

In this regard: twenty blends were prepared by Permutations and combinations containing different ratios of basic emulsifier SNS with other emulsifier package components with (% balanced) paraffinic base oil (30 cSt at $40^{o}C$) were prepared to chose the best blend having excellent characteristics for blend and emulsion stabilities according to IP 311 & IP 263 respectively.

The evaluation indicated that from these twenty blends; four only are successful, which are blends NO. (17, 18.19and20)without anti-corrosion

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Tow additives were synthesized through several trials which are (Abietic diethanolamide & oleic diethanolamide),as anti-wear/ anti-corrosion additives. The structures of the synthesized additives were illustrated by IR spectroscopic analysis.

The successful blends (17, 18, 19 and 20) were reblended with adding the optimum dose of selected prepared anti-corrosion / anti-wear (2 % wt. Abeitic diethanolamide &4% oleic diethanolamide) and evaluated according to IP 263, IP 125 and IP 239 to select the best semi synthetic cutting oil formulation. Applying blend and emulsion stability tests, as well as, anti-wear and anti-corrosion tests revealed that from the four selected blends only two can be considered as the optimum formulation.

The evaluation of the prepared semi synthetic cutting oil blends proved that there is no need to add extreme-pressure additives to them since they have excellent extreme-pressure properties.

These studies indicated that the locally biocide tested samples are effective as anti-bacteria for semi synthetic metal-working oils.

The field trials of the prepared water-soluble semi synthetic cutting oils were carried out at **EL– ARABBEYA FOR INTEGREATED INDUSTRIES CO. (S .A. E) – Third Industrial Zone – Badr City – EGYPT. (ARINCO ISO9001: 2000).**

field trial report indicated that prepared water-soluble semi synthetic cutting oils are successed in the field trials and can be used for **fifteen days** in case of Oil. **2**). and for **seventeen days** in case of **Oil. 1**; while the period use of the commercial cutting oil, based on imported emulsifier package, does not exceed two week. This means that **Oil 1** and **Oil. 2**) is valuable and good for several uses as semi synthetic cutting oils.

The feasibility study showed that : using local materials for preparation of locally semi synthetic cutting oils saving 40% less than imported one at the same performance and dose .